

REMARKS

Claims 1-8, 11-19, 21-32, 62-66 and 69-80 remain in the application. New claims 69-80 are added. The new claims are supported by the originally-filed application by exemplary disclosures of the invention at, for example, pages 9-10. Reconsideration of the application in view of the amendments and the remarks to follow is requested.

Claim 1 stands anticipated over Mizuo. Such claim is amended to recite forming a first isolation trench portion to have a first depth of between five and thirty percent of a sum of the first and second depths within a semiconductor material. The amendment language is supported by the originally-filed application by exemplary disclosures of the invention at, for example, page 11. Mizuo teaches a total depth of a trench equals approximately 4,000 angstroms with a second portion 7 being about 2,000 angstroms, and therefore, the first portion is about 2,000 angstroms (col. 9, Ins. 58-63). That is, Mizuo teaches the first trench portion is about 50 percent of the total trench depth, and does not teach a first depth **of between five and thirty percent**. Accordingly, it is inconceivable that Mizuo teaches or suggests forming a first isolation trench portion to have a first depth of between five and thirty percent of a sum of the first and second depths as positively recited in claim 1. Since Mizuo fails to teach or suggest a positively recited limitation of claim 1, claim 1 is allowable.

Claims 2-4, 8 and 11-12 depend from independent claim 1, and therefore, are allowable for the reasons discussed above with respect to the independent

claim, as well as for their own recited features which are not shown or taught by the art of record.

For example, claim 11 recites planarizing a dielectric material filling first and second isolation trench portions. The Examiner relies on the teachings of Stolmeijer (to planarize an insulating layer) and suggests modifying the Mizuo isolation trench to allegedly teach the limitation of claim 11 (pg. 7 of paper no. 21). The motivational rationale for modifying Mizuo is stated as, it would be obvious to modify Mizuo by the teachings of Stolmeijer since the planarization reduces the size of the device. However, Mizuo explicitly teaches CMP processing of trench oxide film 10 **only down** to a silicon nitride film 3 elevationally above an upper surface of substrate 1 (col. 10, Ins. 9-11; Fig. 3A). Mizuo next teaches that the trench oxide film 10 may be provided as an "HTO film highly resistant to wet etching" so the silicon nitride film 3 is wet etched away selectively leaving the surrounding trench silicon oxide film 10 elevationally extending above the upper surface of substrate 1 "to complete a trench element isolation structure 11" (col. 10, Ins. 12-21; Fig. 3B). The trench oxide film 10 is left extending elevationally above the upper surface of substrate 1 during further processing to form transistors upon the upper surface of substrate 1 (col. 10; Figs. 3-5).

The trench oxide film 10 left elevationally above the upper surface of substrate 1 improves the isolation of respective transistors formed on the same upper surface. Consequently, one skilled in the art would not be motivated to modify the Mizuo isolation trenches with the teachings of Stolmeijer to planarize

the trenches of Mizuo because such would destroy a purpose of the Mizuo isolation trench structure. “Preferably the Examiner’s explanation should be such that it provides that impetus necessary to cause one skilled in the art to combine the teachings of the references to make the proposed modification.” *Ex Parte Levengood*, 28 USPQ2d, 1300, 1301, Footnote 2, (Bd. Pat. App. and Inter. 1993) (citations omitted). The Examiner has failed to provide that impetus, and therefore, the motivational rationale presented by the Examiner does not exist. Since a proper motivational rationale is not presented as required for a proper obviousness rejection, the obviousness rejection against claim 11 must fail. For at least this reason, claim 11 is allowable.

Claim 5 stands rejected as being obvious over the combination of Mizuo and Yu. Such claim is amended to recite plasma etching through a silicon nitride layer using plasma conditions that also deposit a polymer on the masking layer sidewalls; continuing the plasma etching for a predetermined time interval after the silicon nitride layer has been etched through and continuing to deposit polymer on the masking layer sidewalls **to form the first isolation trench portion using the same plasma conditions**. The amendment language is supported by the originally-filed application by exemplary disclosures of the invention at, for example, page 9. Mizuo does not teach plasma conditions (or any etch conditions) for silicon nitride film 3 (col. 8, lns. 35-65), and therefore, no comparison of plasma conditions can be performed regarding etching of a first trench 4. Yu teaches a RIE procedure using $\text{CF}_4\text{-CHF}_3\text{-Ar}$ as an etchant for a

silicon nitride layer 3 (col. 3, Ins. 9-14) and another RIE procedure using either HBr-Cl₂-O₂ or Cl₂-O₂ to etch a shallow trench 7 (col. 3, Ins. 34-40). That is, Yu teaches using different RIE conditions for etching the silicon nitride layer relative the shallow trench. Consequently, it is inconceivable that Mizuo and Yu, singularly or in any combination, teach or suggest **to form the first isolation trench portion using the same plasma conditions** as positively recited in claim 5. Since Mizuo and Yu fail to teach or suggest a positively recited limitation of claim 5, claim 5 is allowable.

Claims 6-7 depend from independent claim 5, and therefore, are allowable for the reasons discussed above with respect to the independent claim, as well as for their own recited features which are not shown or taught by the art of record.

Claim 13 stands rejected as being obvious over the combination of Mizuo and Yu. Such claim recites etching into the silicon wafer using gases including CF₄ and CHF₃ in a ratio of CF₄/CHF₃ from 0.11 to 0.67 to form a first isolation trench portion. Mizuo teaches a dry etch using a chlorine (Cl₂) or a mixture of hydrogen bromide (HBr) and chlorine to form a first trench 4 (col. 8, lines 50-65). Yu teaches an RIE procedure using either HBr-Cl₂-O₂ or Cl₂-O₂ to etch a shallow trench 7 (col. 3, lines 33-40). Neither reference teaches using CF₄ or CHF₃ as etching gases of a trench portion, and therefore, it is inconceivable that Mizuo and Yu, singularly or in any combination, teach or suggest etching into the silicon wafer using gases including **CF₄ and CHF₃ to form a first isolation trench**

portion as positively recited in claim 13. Since Mizuo and Yu fail to teach or suggest a positively recited limitation of claim 13, claim 13 is allowable.

Claims 14-21 depend from independent claim 13, and therefore, are allowable for the reasons discussed above with respect to the independent claim, as well as for their own recited features which are not shown or taught by the art of record.

Claim 22 stands rejected as being obvious over the combination of Noguchi and Sakai. Such claim recites **doping** a bottom portion of silicon of a second isolation trench portion. Noguchi and Sakai are devoid of teachings to doping within a trench, and respectfully, the Examiner does not point to any specific teachings of the references to such limitation other than simply reciting the limitation (see e.g., pg. 10 of paper no. 21). Accordingly, Noguchi and Sakai, singularly or in any combination, fail to teach or suggest doping a bottom portion of silicon of the second isolation trench portion as positively recited by claim 22. Since Noguchi and Sakai fail to teach or suggest a positively recited limitation of claim 22, claim 22 is allowable.

Claims 23-24, 27-32 and 62-64 depend from independent claim 22, and therefore, are allowable for the reasons discussed above with respect to the independent claim, as well as for their own recited features which are not shown or taught by the art of record.

Claim 25 stands rejected as being obvious over the combination of Noguchi, Sakai and Yu. Such claim is amended to recite plasma etching through an oxide layer using plasma conditions that also deposit a polymer on

sidewalls; continuing plasma etching for a predetermined time after the oxide layer has been broached and continuing to deposit polymer on the sidewalls **to form the first isolation trench portion using the same plasma conditions.**

The amendment language is supported by the originally-filed application by exemplary disclosures of the invention at, for example, page 9. The Examiner correctly states Noguchi and Sakai do not teach this limitation and relies on Yu to provide the deficiency in teachings (pgs. 11-12 of paper no. 21). However, Yu teaches a RIE procedure using $\text{CHF}_3\text{-CF}_4\text{-Ar-CO}$ as an etchant for an oxide layer 2 (col. 3, Ins. 9-14) and another RIE procedure using either $\text{HBr-Cl}_2\text{-O}_2$ or $\text{Cl}_2\text{-O}_2$ to etch a shallow trench 7 (col. 3, Ins. 34-40). That is, Yu teaches using different plasma RIE conditions for etching the oxide layer relative the shallow trench. Consequently, it is inconceivable that Noguchi, Sakai and Yu, singularly or in any combination, teach or suggest **to form the first isolation trench portion using the same plasma conditions** as positively recited in claim 25. Since Noguchi, Sakai and Yu fail to teach or suggest a positively recited limitation of claim 25, claim 25 is allowable.

Claim 26 depends from independent claim 25, and therefore, is allowable for the reasons discussed above with respect to the independent claim, as well as for its own recited features which are not shown or taught by the art of record.

Claim 65 stands rejected as being obvious over the combination of Mizuo and Yu. Such claim is amended to recite plasma conditions comprising a

mixture of gases chosen from a group consisting of CF_4 , CHF_3 , CH_2F_2 and C_2F_8 ; continuing plasma etching for a predetermined time interval after the silicon nitride layer has been etched through and continuing to deposit polymer on the masking layer sidewalls **to form the first isolation trench portion using the same plasma conditions**. The amendment language is supported by the originally-filed application by exemplary disclosures of the invention at, for example, page 9. Mizuo does not teach plasma conditions (or any etch conditions) for silicon nitride film 3 (col. 8, Ins. 35-65), and therefore, no comparison of plasma conditions can be performed regarding plasma conditions for etching a first trench 4. Yu teaches a RIE procedure using CF_4 - CHF_3 -Ar as an etchant for a silicon nitride layer 3 (col. 3, Ins. 9-14) and another RIE procedure using either $\text{HBr-Cl}_2\text{-O}_2$ or $\text{Cl}_2\text{-O}_2$ to etch a shallow trench 7 (col. 3, Ins. 34-40). That is, Yu teaches using different RIE conditions for etching the silicon nitride layer relative the shallow trench. Consequently, it is inconceivable that Mizuo and Yu, singularly or in any combination, teach or suggest **to form the first isolation trench portion using the same plasma conditions** as positively recited in claim 65. Since Mizuo and Yu fail to teach or suggest a positively recited limitation of claim 65, claim 65 is allowable.

Claim 66 depends from independent claim 65, and therefore, is allowable for the reasons discussed above with respect to the independent claim, as well as for its own recited features which are not shown or taught by the art of record.

New independent claim 69 recites **over-etching** through an upper surface of a semiconductor substrate to form a first isolation trench portion within the semiconductor substrate, the first isolation trench portion having a first depth within the semiconductor substrate and having a first sidewall intersecting the upper surface of the semiconductor substrate at a first angle. The art of record, singularly or in any combination, fail to teach or suggest such limitation. Yu teaches over-etching to form a thicker polymer spacer 6b over exposed sidewalls of opening 5a formed through an oxide and nitride layer formed over a substrate (col. 3, lines 20-40), not to form an isolation trench portion. Accordingly, new claim 69 is allowable.

New independent claim 79 recites etching through a masking layer and exposing an upper surface of a semiconductor substrate, the etching comprising an environment of etch gases with respective ratios of component gases; etching through the upper surface of the semiconductor substrate to form a first isolation trench portion within the semiconductor substrate, **the etching comprising the environment of the same etch gases and the same respective ratios of the component gases**, the first isolation trench portion having a first depth within the semiconductor substrate and having a first sidewall intersecting the upper surface of the semiconductor substrate at a first angle. The art of record, singularly or in any combination, fails to teach or suggest etching through the upper surface of the semiconductor substrate to form a first isolation trench portion **comprising the environment of the same etch gases and the same respective ratios of**


the component gases as positively recited in claim 79. New claim 79 is allowable.

Further, Applicant herewith submits a duplicate copy of the Supplemental Information Disclosure Statement and Form PTO-1449 filed in this application on March 10, 2003. No initialed copy of the PTO-1449 has been received back from the Examiner. To the extent that the submitted references listed on the Form PTO-1449 have not already been considered, and the Form PTO-1449 has not been initialed with a copy being returned to Applicant, such examination and initialing is requested at this time, as well as return of a copy of the initialed Form PTO-1449 to the undersigned.

This application is now believed to be in immediate condition for allowance, and action to that end is respectfully requested. If the Examiner's next anticipated action is to be anything other than a Notice of Allowance, the undersigned respectfully requests a telephone interview prior to issuance of any such subsequent action.

Respectfully submitted,

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